The Network for Environment and Weather Applications: 2017 Survey of Impacts and User Insights

Project Leader(s):
Daniel L. Olmstead, New York State IPM Program, Cornell University
Juliet E. Carroll, New York State IPM Program, Cornell University

Cooperator(s):
Terence Bradshaw, University of Vermont; Jon Clements, University of Massachusetts; Mary Concklin, University of Connecticut; Robert Crassweller, Pennsylvania State University; Art DeGaetano, Northeast Regional Climate Center, Keith Eggleston, Northeast Regional Climate Center; Jennifer Grant, New York State IPM Program; Melanie Ivey, The Ohio State University; JP Jacobson, Minnesota Apple Growers Association; Elizabeth Lamb, New York State IPM Program; Mizuho Nita, Virginia Tech; Peter Oudemans, Rutgers University; Dave Robinson, Rutgers University; Abby Seaman, New York State IPM Program; Cheryl Smith, University of New Hampshire; Mike Parker, North Carolina State University; Matt Wallhead, USDA at The Ohio State University; Tim Weigle, New York State IPM Program

Abstract:
The Network for Environment and Weather Applications (NEWA) is an online decision aid system providing growers with results from IPM risk assessment models based on local weather and forecast data. An online survey of NEWA users and non-users was designed with 48 questions to (1) collect demographic information, (2) measure IPM impact, (3) determine the utility of current and desired content, and (4) assess user experience to guide a website redesign. Of the 331 respondents, 54% were current users. Results showed that the average NEWA user annually saves $4,329 by reducing pesticide sprays and $33,048 by preventing crop loss. Their average per acre savings as a direct result of using NEWA was $2,060 annually. All NEWA users would recommend NEWA to other farmers. Insights gained for desired elements in a web redesign included insuring continued reliability of IPM forecasts, easy viewing of multiple locations or models, and saved personal profiles.

Background and Justification:
Established in 1996 by the New York State IPM Program at Cornell University with 22 weather stations, NEWA is a digital decision aid system providing fruit and vegetable growers with IPM risk assessment model results based on local weather and forecast data. The current NEWA web platform, newa.cornell.edu, was launched in 2009; informed by a 2007 survey of NEWA users and non-users (Carroll 2018). The success of the NEWA platform paved the way for significant expansion of NEWA in the ensuing 10 years. NEWA now includes over 650 weather stations throughout the Northeast, Mid-Atlantic, and Upper-Midwest US. At the time of this survey there were 12 partnering states with membership support from land grant institutions and grower associations, including Connecticut, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Vermont, and Virginia. This survey gathered user and non-user demographics, measured IPM impact, determined current and desired needs, and assessed NEWA user experience. Collected data will inform the planned NEWA redesign to best address grower preferences, capitalize on new internet technologies, accommodate mobile devices, and deliver attribution to and resources from partnering states.

Objectives:

1. Measure the IPM and financial impact of NEWA.
2. Understand the demographics of NEWA users and potential new users.
3. Determine the utility of current website content, desired new content, and assess user experience.

Procedures:

Survey questions about user demographics, website content needs, and user experience were drafted by Olmstead, Carroll, and NEWA State Coordinators and then reviewed by the Cornell Survey Research Institute. Users and non-users answered a common set of seven introductory questions. Non-users answered two exit questions designed to gain insight into why they do not use NEWA. Users were presented with 39 additional questions before exiting the survey. To provide a 10-year perspective on NEWA's impact, a subset of questions from the 2007 survey were repeated in the 2017 survey.

An electronic survey instrument was created using the Qualtrics online platform (www.qualtrics.com). Project cooperators distributed the survey via email, listservs, newsletters, meetings, and blogs using an anonymous URL and short project description. Responses were collected from 1 September 2017 to 31 January 2018. Quantitative survey responses were analyzed using basic summary methods. Surveys were completed by 398 participants in 14 US states and one Canadian province. Almost half of all participants resided in New York State. Qualitative text-based responses were placed into categories supporting the quantitative analysis. Preliminary data were presented in a poster at the 9th International IPM Symposium, Baltimore, MD (Olmstead et al. 2018).

Results and discussion:

IPM impact

NEWA is a reliable and trusted source of information among users. All respondents said they would recommend NEWA to other growers. They also said NEWA provides reliable IPM information to support responsible management practices, enhance decision-making, and increase awareness of risks. When asked directly if NEWA helps you to improve timing of pesticide applications, 96% answered yes. Growers use NEWA to improve pesticide application timing, reduce spray applications, and reduce crop loss. These findings were consistent with 2007 survey results (Fig. 1 A and B).

Among NEWA users responding to the survey, more strongly agreed in 2017 that NEWA has a positive impact on IPM practices than did in 2007, though combined results were similar:

- 77% agreed or strongly agreed that NEWA pest forecast information helps them reduce the number of sprays they apply to control diseases, insects, mites, or weeds, compared to 81% in 2007.
- 86% agreed or strongly agreed that NEWA pest forecast information alerts them to the risk of pest damage, compared to 90% in 2007.
- 93% agreed or strongly agreed that NEWA pest forecast information enhances IPM decision-making for their crops, compared to 96% in 2007.

- 95% agreed or strongly agreed that NEWA pest forecast information improves timing of their spray applications (fungicides, insecticides, miticides, or herbicides), compared to 93% in 2007.

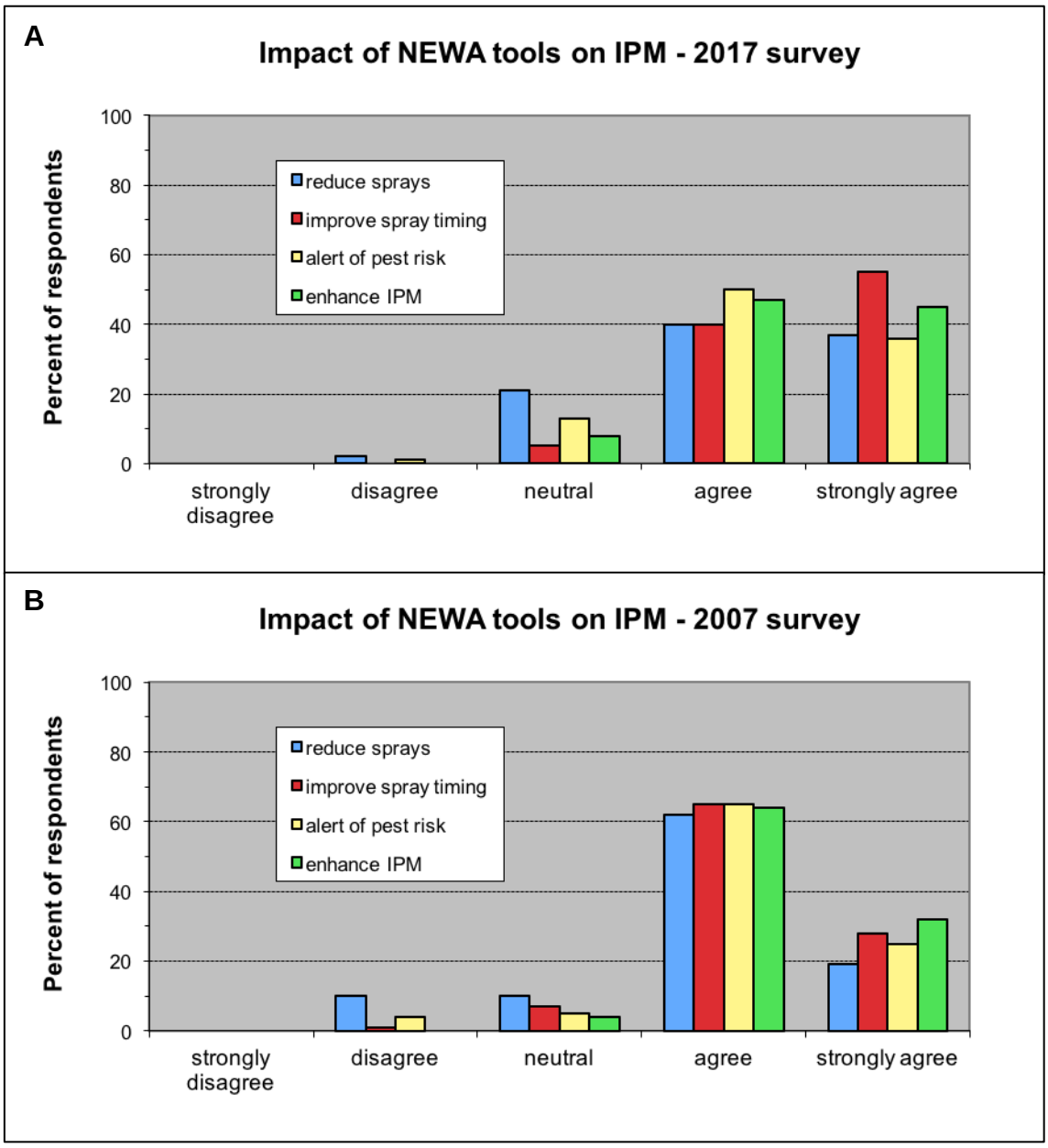

Figure 1. (A) 2017 survey responses (n=166) to questions on the impact of NEWA on IPM practices, compared to (B) the survey responses in 2007 (n=113, NY only).

As a direct result of using NEWA pest forecast tools, 75% of growers are saving money on their spray bill. Grower respondents to the 2017 survey estimated annual savings of, on average, $4,329 from reducing pesticide sprays. In 2017, the pest forecast tools on NEWA also helped growers prevent, on average, $33,048 in crop loss annually. Translating costs into per acre savings, 44 respondents reported an average per acre savings of $2,060 annually, through reduced sprays and avoided crop loss.

Demographics

Who users are. Among NEWA users, 75% are growers and 10% are extension educators. Of the growers, 60% manage diversified farm operations. The size of their farms ranged mostly from 11 to 1000 acres (57% of respondents), with a small proportion (4%) managing farms greater than 1000 acres, and 20% farming 2 to 10 acres. Among non-users, the majority of respondents (44%) farmed less than 10 acres.

What users grow or work with. Most NEWA users surveyed grow apples (46%); other tree fruit (37%); grapes (34%); berries (25%); and tomatoes (25%). A majority produce two or more commodities; 23 other commodities not supported by commodity-specific NEWA tools were reported by NEWA users (Table 1).

Table 1. Commodities NEWA users grow or work with, sorted within commodity groupings. Percentages calculated from responses within a single commodity grouping.

Fruit (164 respondents)		**Vegetables (63 respondents)**	
Apples	46%	Cucurbits	27%
Other tree fruit	37%	Tomatoes	25%
Grapes	34%	Sweet corn	17%
Berries	25%	Legumes	14%
		Alliums	13%
Field Crops (32 respondents)		Crucifers	8%
Corn	44%	Peppers	8%
Hay	34%	Eggplant	6%
Alfalfa	25%	Potatoes	6%
Soybeans	22%	Root vegetables	6%
Other	9%	Greens	5%
Livestock (19 respondents)		**Ornamentals (24 respondents)**	
Beef	37%	Trees and shrubs	29%
Sheep	32%	Flowers	29%
Equine	26%	Other	15%
Poultry	21%		
Swine	16%		

NEWA currently provides fruit and vegetable tools, whereas the survey results show users produce other commodities. Therefore, additional NEWA tools for field crops, livestock and ornamentals are needed, as well as for other fruit and vegetables not covered.

Users who manage diversified operations will benefit from NEWA tools in these production areas and an interface that displays the results for several models simultaneously.

User support, outreach, and audience growth. Of the 331 survey respondents, 151 do not use NEWA. A majority (59%) of non-users indicated a lack of awareness when asked why they don't use NEWA. Another 25% responded by saying they don't know how to use NEWA. Coordinated effort to increase NEWA awareness is needed. Educational resources, workshops, and presentations would help recruit NEWA users who could benefit from its impact on improving their IPM practices.

Where users live. People responding to the NEWA online survey were primarily located in the region of states that are part of NEWA, though single responses came from other locations including California, Florida, Georgia, Illinois, Maryland, North Carolina, and Canada (Fig. 2).

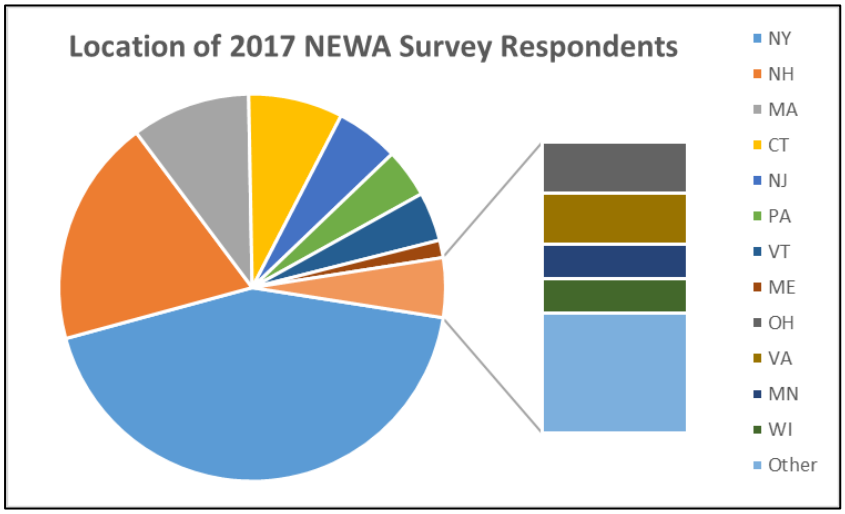

Figure 2. The US state where NEWA survey respondents live and farm. The "Other" category included respondents from California, Florida, Georgia, Illinois, Maryland, North Carolina, and Canada.

Models, tools, and resources
This section provides responses about website use during the prior 12 months, or the 2017 growing season. Long-term trends or usage of recently created tools may not be accurately reflected.

Obtaining NEWA results via downloading in PDF, XLS, or CSV formats was selected by 28% of survey participants (n=170). A majority, 46%, chose automatic text or email alerts when NEWA detects risk, which is a similar approach being used in a beta product, eNEWA for grapes.

NEWA weather data tools. All products were chosen as having been used at similar levels (n=178): degree day tables (70%), daily summaries (67%), hourly data tables (52%), and a degree day calculator (49%) — only recently developed for NEWA.

Apple model use. Apple scab, fire blight, apple maggot, codling moth, plum curculio and the apple carbohydrate thinning models were indicated as used most frequently by respondents (Fig. 3). The percentage use was based on the number of respondents to the model use questions for diseases, insects, and crop management, which were 92, 77, and 76, respectively.

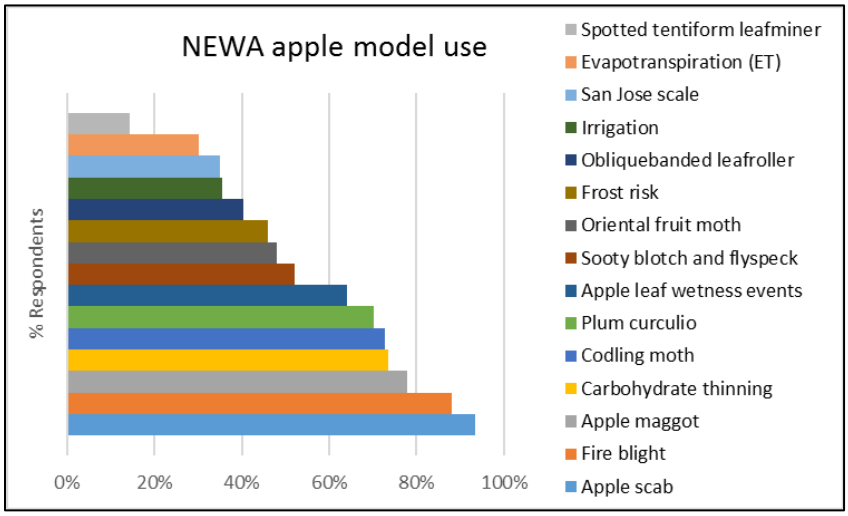

Figure 3. Relative frequency of NEWA apple model use in the prior twelve months, chosen by respondents.

Grape model use. All five grape tools were used at similar frequency among grape growers responding to these questions (n=72): grape berry moth 93%, black rot 83%, powdery mildew 82%, downy mildew 82%, and Phomopsis leaf and cane spot 79%.

Vegetable model use. Fewer vegetable than fruit models are available on NEWA. Cabbage maggot and onion maggot models are popular among growers (Fig. 4). Percentage use was based on the number of respondents to disease and insect model questions, which were 35 and 20, respectively. NEWA vegetable tool development is an area for future growth. In addition, promotion and education on how to use existing vegetable tools would increase use.

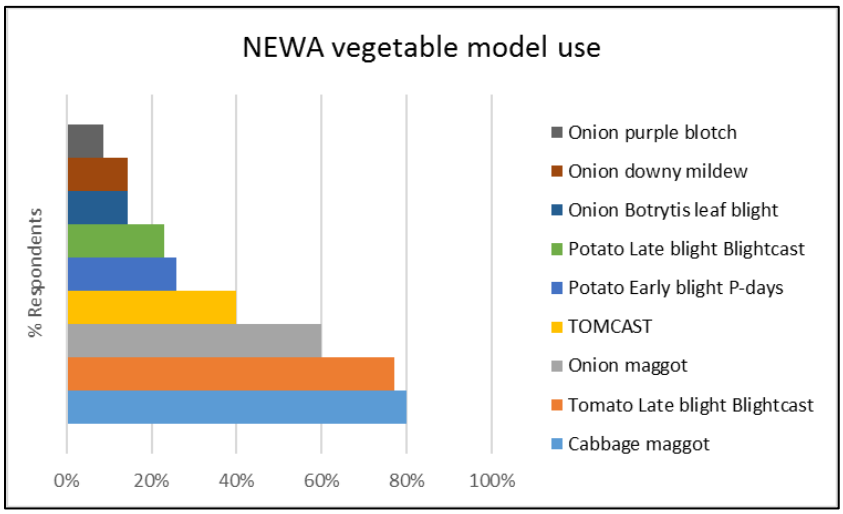

Figure 4. Relative frequency of NEWA vegetable model use in the prior twelve months, chosen by respondents.

Crop management model use. In addition to the apple crop management tools (Fig. 3), growing degree days tables (74%) and the degree day calculator (52%) were used frequently, while maps of soil temperature (17%) and turf evapotranspiration (3%) were used less frequently (n=150).

Other tool use. NEWA provides outbound links to other tools and 39% of users access these. Most popular are weather information links such as NOAA radar maps and USDA drought maps; and national platforms such as the late blight USABlight and the iPIPE for Cucumber Downy Mildew. The Stewart's wilt of sweet corn risk map and the turfgrass disease risk tool were used by very few survey respondents, four and three, respectively. Recent technological advances will allow better integration of these resources and should be considered for development within the NEWA platform.

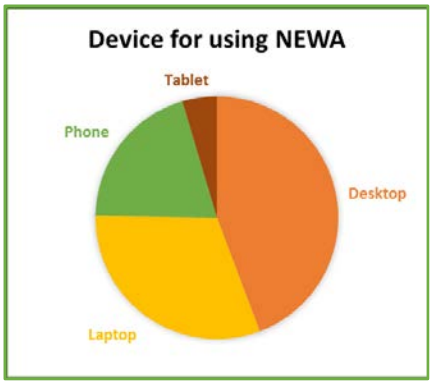

Figure 5. Proportion of NEWA access on different devices.

Website user experience

Responsive design. Website accessibility is important. Because NEWA users (n=174) access the website on numerous devices (Fig. 5), the website rebuild must use technology that detects device screen size and prioritizes content for optimal viewing across all devices, i.e. responsive design. Desktop or laptop computers will continue to dominate office-based NEWA access, but we anticipate phones will become the device of choice to access NEWA in the field.

Customized user experience. The majority of users wanted NEWA to remain open access, with an optional password login (62%). And 25% wanted no login. However, a login will enable development of a much-needed user profile system to save a user's biofix information and crop phenology data — both essential to run the models. There is also strong support for personalized features including 1-10 specified NEWA station location(s), specified model results, specified weather data, as well as customized viewing of multiple station or multiple model results. In summary, users want:

- NEWA to remain open access.
- An integrated user profile system to enable customized user experience.
- User-selected weather stations, models, and weather data tools.
- The addition of multiple station and multiple model result summaries.

Weather station pages. Existing items to include on NEWA's redesigned weather station pages, in order of importance gauged by the survey, are: station pest forecast links; station location maps, latitude/longitude/elevation, and last download date and time; active sensor list; weather data quick links; NWS forecast; and helpful Extension links. Of least importance were 'About NEWA' links and statewide and regional forecast links.

Users also want a suite of new features including, in order of importance: hourly weather forecasts, 5-day forecasts, radar and satellite maps, regional resource links, drought severity index, and improved historical data access. Each weather station page should present the station's affiliation or sponsor and the NEWA state-level contact person.

Model results interface. Although the usefulness of heat maps was identified by 66% of survey respondents, the majority indicated a preference for model results displayed in tables (96%) and graphs (87%). The presentation of NEWA model results will be tested for usability with target end users to ensure effective delivery.

What users like and don't like about the website. Reliability is paramount to NEWA's success at delivering useful IPM information to growers (Figs. 6 and 7). Website navigation and appearance are key areas for improvement (Fig. 7).

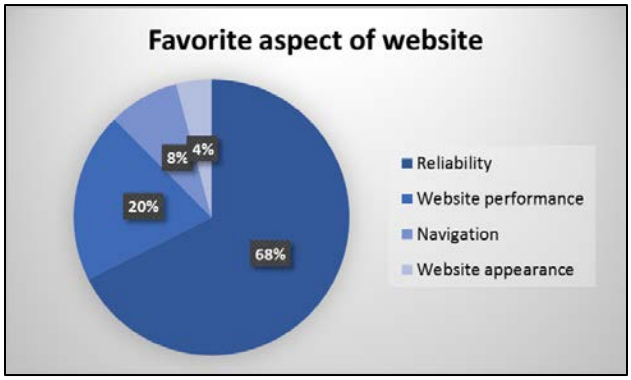

Figure 6. NEWA user responses on what they like ***most*** about the website.

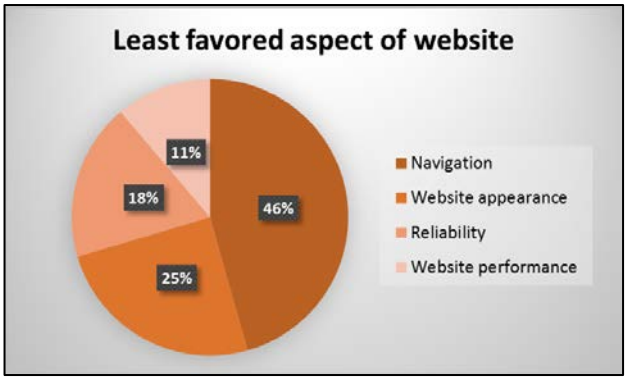

Figure 7. NEWA user responses on what they like ***least*** about the website.

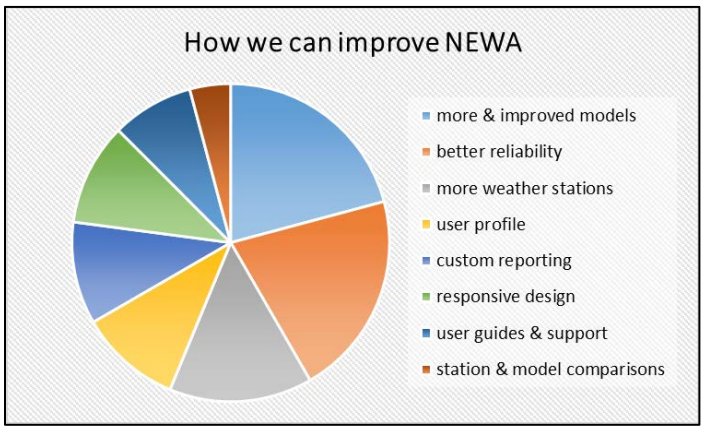

Figure 8. Comments from 48 NEWA users on ways to improve the NEWA website.

Parting comments

We welcomed final comments regarding NEWA and ways to improve the website and tools. Of the 71 people responding to this question, 23 (32%) stated that NEWA was excellent and thanked us for NEWA. One response bears quoting directly,

"I would suggest NEWA be a part of any subsidized agriculture. I would like to see the NEWA network as a standard tool of ag, more important than a NEW JOHN DEERE."

Comments from 48 respondents were organized into similar topic areas. These supported the priorities for the NEWA website rebuild and future development (Fig. 8)

Final recommendations

Website considerations

- Understand that a large majority of NEWA users are growers who manage diversified operations, therefore,
  - provide model results for multiple crops simultaneously, and
  - develop pest forecast and crop management models for new commodities.
- Consolidating the presentation of NEWA models within a commodity would improve navigation to, and awareness of, the NEWA resources for that commodity. That in turn could increase overall usage. For example, a summary page showing brief results of the apple disease, insect, and crop management models.
- Web technologies that maximize website speed and versatility across a range of device screen sizes is critical for the NEWA website rebuild to ensure a positive user experience.
- An optional open access version is very important along with a user profile system that requires login. The open access NEWA should provide improved navigation for an excellent experience when new users 'Test Drive' and become familiar with the decision aid platform.
- The ability for the user profile to enable customized viewing experience is essential because multiple station and multiple model viewing are high priority features.
- Weather station pages need to provide improved weather and model resources for open access viewing and be versatile to allow for the individualized needs of a given user profile calling for subsets of resources.
- The user experience must be a priority when existing NEWA models are incorporated into the redesigned website and when new models are built in the future.

Education and promotion

- At workshops and conferences, promote the high level of trust and reliability growers have in NEWA to categorize pest risk and provide IPM recommendations.

- Raise awareness among growers that using NEWA can result in better spray timing, significant savings on spray bills, and improved crop protection.
- A promotion and awareness campaign for NEWA vegetable models and extension education on how to use them is needed, because vegetable production is significant throughout NEWA's region — however, reported usage is low.
- A coordinated effort is needed to develop online educational resources for new and existing NEWA users that can be used independently and in workshops and presentations.
- A well-executed awareness campaign can reach new audiences and should bring new users to NEWA resources, and encourage them to start using the platform.

Future development

- To expand and enhance NEWA, focus on and recruit future development in the areas of vegetable, ornamental, and field crop production and pest forecast models.
- Because NEWA weather data products are valued and accessed by all users, develop innovative weather products to attract future NEWA users.

References

Carroll, J.E. 2008. Impact of NYS IPM Program's Network for Environment and Weather Awareness (NEWA) on agricultural production. NYS IPM Program Project Reports 2007-2008, NYS IPM Pub 506: 261-267.

Olmstead, D., Carroll, J., Weible, T., Grant, J., and Petzoldt, C. 2018. Grower Valuation of the Network for Environment and Weather Applications. Poster, 9th International IPM Symposium, Baltimore, MD.

Acknowledgements

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